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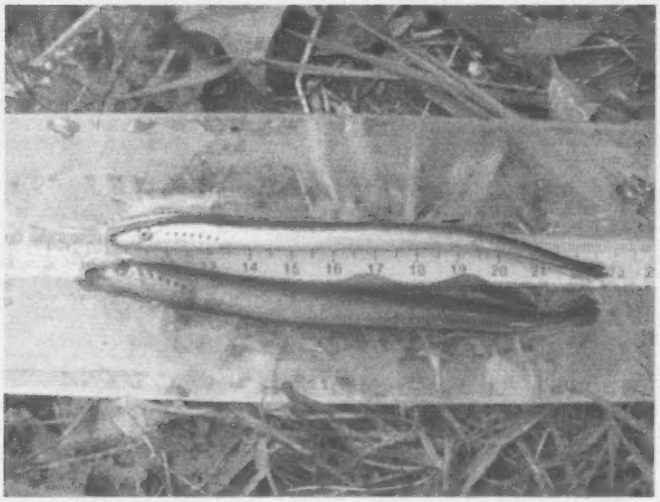
Science Advisory Report 2015/009

REVIEW OF THE INFORMATION FOR THE IDENTIFICATION OF CRITICAL HABITAT FOR MORRISON CREEK LAMPREY



Morrison Creek lamprey and common form of Western Brook Lamprey.(D. Beamish 2012 photo credit)

Figure 1. Morrison Creek and Arden Creek and associated wetlands (in red).

Context

The Morrison Creek lamprey is a unique life history form of the Western Brook lamprey (Lampetra richardsoni) that occurs only in Morrison Creek, Vancouver Island. Its extreme endemic distribution is the principal factor in its designation as "endangered," and suggests that it will always remain at some risk.

A variety of factors threaten the Morrison Creek lamprey and its associated habitat. The primary threat is impacts associated with urbanization of the watershed. Morrison Creek lamprey was listed in 2003 as Endangered under the Species at Risk Act (SARA), and a Recovery Strategy for the species was completed in 2007 (National Recovery Team for Morrison Creek Lamprey 2007). A SARA Recovery Strategy or Action Plan must identify an endangered species' Critical Habitat, or "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species critical habitat in the Recovery Strategy or action plan for the species". Under SARA s41(1)(c) a species' critical habitat must be identified to the extent possible, based on the best available information.

The Fisheries and Oceans Canada SARA Management Program has requested science advice in support of the identification of critical habitat and residence, and development of the Action Plan for the Morrison Creek Lamprey under SARA.

This Science Advisory Report is from the October 29, 2013 Review of the Information for the Identification of Critical Habitat for Morrison Creek Lamprey. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Canada

SUMMARY

- Morrison Creek lamprey was listed in 2003 as Endangered under the Species at Risk Act (SARA), and a Recovery Strategy for the species was completed in 2007 (National Recovery Team for Morrison Creek Lamprey 2007). A variety of factors threaten the Morrison Creek lamprey and its associated habitat. The primary threat is impacts associated with urbanization of the watershed.
- *Lampretra richardsoni var. marifuga* (Morrison Creek lamprey) has only been identified in the Morrison Creek watershed.
- The Morrison Creek lamprey is a variety of the widely distribution Western Brook lamprey *(L. richardsoni)*. The two varieties can only be distinguished from each other after metamorphosis. Therefore, Critical Habitat must include areas that support all lamprey found in Morrison Creek.
- No quantitative population estimates exist for either variety of lamprey in Morrison Creek. However, catch studies indicate a general decline in numbers over the past 30 years.
- Habitat requirements vary depending on the life stage of lamprey and include regions of free-running fresh water in both main and side channels for adults, slow moving regions with small pebbles and gravel for nests and spawning, and loose silt or sand substrate suitable for burrowing ammocoetes.
- During spawning the nests built by the lamprey within the Morrison Creek watershed would be considered residences as they are discrete dwelling places, adults of both sexes invest energy physically moving pebbles with their oral discs to create the nests, the nests support the life-cycle process of spawning and egg incubation, and the nests are occupied by multiple individuals.
- The primary activities likely to threaten Morrison Creek lamprey are those that harm or destroy their Critical Habitat. These include, but are not limited to: land-based activities that directly or indirectly alter their aquatic habitat including forestry, mining, and land development; alteration of stream bed composition to benefit other species, including salmon; water withdrawals or impoundments that alter the natural variability in water flow; releases of deleterious substances into the watershed; riparian vegetation removal; and, activities that result in significant sediment inputs.
- The hydrology of Morrison Creek is poorly understood. Although the wetland area at the headwaters of the creek is vital to the continued source of cool water, the source of water supplying this area has not been identified. It is recommended that a hydrology study be undertaken to understand the relationship between the water sources and discharges from the system.
- The high uncertainty of a number of factors related to Morrison Creek lamprey make the identification of Critical Habitat difficult. These factors include, but are not limited to: the type and abundance of prey required, the type of vegetation required to maintain the functions of the riparian zone, and the location of spawning sites with the creek. Therefore, further work is suggested to provide quantitative thresholds for Critical Habitat attributes.
- It is recommended that the entire wetted area, channel, and headwaters of Morrison Creek be considered Critical Habitat for the Morrison Creek lamprey.

INTRODUCTION

The Morrison Creek lamprey (*Lampetra richardsoni* var. *marifuga*) is only found in the Morrison Creek watershed, on Vancouver Island. It is a variety of the Western Brook lamprey (L. *richardsoni)*. The

Western Brook lamprey is widely distributed, resides only in freshwater, is non-parasitic and does not feed as an adult. The Morrison Creek lamprey is endemic to Morrison Creek and produces both a parasitic and non-parasitic life history type (Beamish 1985, Beamish and Withler 1986, Beamish et al., 2001, Youson and Beamish 1991).

It is hypothesized that some unknown trigger, perhaps an environmental trigger, enables the Morrison Creek lamprey variety to be expressed within the larger lamprey population in Morrison Creek. Given this is a unique situation and that Morrison Creek lamprey cannot be differentiated from the typical form of Western Brook until after metamorphosis, Critical Habitat that supports all lamprey found in the Morrison Creek watershed is needed.

Morrison Creek lamprey was listed in 2003 as Endangered under the Species at Risk Act (SARA), and a SARA Recovery Strategy for the species was completed in 2007. (National Recovery Team for Morrison Creek Lamprey 2007). A Recovery Strategy or action plan must identify an endangered species' Critical Habitat, or "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species Critical Habitat in the Recovery Strategy or action plan for the species". Under SARA s41(1)(c) a species' Critical Habitat must be identified to the extent possible, based on the best available information.

ASSESSMENT

Critical Habitat is defined in the Species at Risk Act (2002) section 2(1) as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' Critical Habitat in the Recovery Strategy or in an action plan for the species".

The identification of Critical Habitat in the context of SARA must:

- Specify the geospatial location of the Critical Habitat or describe the area within which Critical Habitat is found.
- Describe the known biophysical functions, features and attributes of that Critical Habitat that are required by the listed wildlife species in order to carry out life processes necessary for its survival or recovery.
- Provide a sufficient level of detail to allow a person to determine whether a particular location is part of Critical Habitat.

Western Brook lamprey spawn in nests constructed by both sexes in fine sediment. After hatching, larvae remain in sediment for several weeks, and then are swept downstream. In these downstream regions, they burrow in mud and as ammocoetes filter feed on detritus for a period of three to seven years, although actual length of time is unknown (Beamish et al. 1999). Ammocoetes undergo metamorphosis into adults in September. They overwinter in gravel and spawn and die the following May to July. It is only after metamorphosis that differences between the Morrison Creek lamprey and Western Brook lamprey can be identified. At this time, the teeth of the Morrison Creek lamprey remain sharp, whereas those of Western Brook lamprey are worn and blunt. The Morrison Creek lamprey is presumed to feed by parasitizing a variety of fish species, and in lab studies has been shown to live for up to one year longer than Western Brook lamprey. Unlike typical Western Brook lamprey, Morrison Creek are silver in colouration and will retain the colour until the end of September, prior to spawning (Beamish 1985, 1987).

No quantitative population estimates exist for either the Morrison Creek lamprey or the Western Brook lamprey in Morrison Creek. However, Beamish (2013) summarizes the catch and biological information of survey efforts from the late 1970s and 1980s. These data and data from similar catch studies in 2011 and 2012 indicate that catches of the Morrison Creek lamprey have decreased over the past 30 years.

Adult and Metamorphosing Lamprey

Habitat for the adult (non-spawning) Morrison Creek lamprey consists of areas of free running fresh water flowing into Morrison Creek, Morrison Creek itself, as well as natural and artificial side channels and tributaries to the Creek. Metamorphosing lamprey are often found in areas of the creek around, or under, large woody debris, small woody debris, small boulders and bank overhangs. These areas provide shelter for both adult and metamorphosing lamprey. Recently metamorphosed and metamorphosing lamprey are also found burrowed in muddy or silty areas. These types of substrates are found throughout Morrison Creek.

Spawning Lamprey and Egg Incubation

To build their nests, lamprey require pebbles or gravel of a size that can be moved either by mouth or with their bodies. Average oral disc diameter of spawning Morrison Creek lamprey is 1.01cm (Beamish and Withler 1986). Morrison Creek lamprey build spawning nests in narrower segments of the creek with lower water flow, containing hard substrate covered with small pebbles. Recently, spawned-out lamprey were captured in passive downstream traps in areas of Morrison Creek possessing these characteristics. Small nests have also been found near trapping locations with lamprey tending some of these nests.

Ammocoetes

Once lamprey eggs hatch, the ammocoetes burrow into the substrate downstream of the nest. Although it is not known how long Morrison Creek lamprey spend as an ammocoete, it has been estimated to be as long as seven years based on observations of other, similar lamprey species. Ammocoetes are motile and have the ability to move from place to place actively filter feeding on detritus. The types of detritus they are feed upon is not known. Recent electroshocking surveys indicated that ammocoetes were found in low to medium flow areas where the substrate is composed of loose silt, sand or mud.

Morrison Creek Watershed

Morrison Creek drains a small, low relief system and is unlikely to have extremely high flows at any time of year; however, the wetland area at the head of the creek plays a vital role in the continued supply of cool water. Some of this area is now protected within the Linton Conservation Area. There are several wetland areas at the head of Morrison Creek between the Inland Island Highway, Pidgeon Lake Road and Lake Trail Road that supply water for the Morrison/ Arden creek watershed area (Figure 1). Further work is required to determine the precise hydrology of the area, including the potential contribution of water from Maple Lake. There are numerous small tributaries and side channels within the watershed; these include both natural and man-made channels. Arden Creek enters Morrison Creek a short distance (0.9km) before its confluence with the Puntledge River. It is unknown whether Morrison Creek lamprey are found in Arden Creek, although there is little reason to believe they would not be present in this small creek.

Identifying Riparian Area Width

Riparian areas play an important part in preserving and contributing to the characteristics of aquatic ecosystems. In order to define the width of the riparian buffer that should be included in the Critical Habitat being identified for Morrison Creek lamprey, it is recommended that the British Columbia Riparian Area Regulation (RAR) methodology be applied to Morrison Creek. The results of this analysis will recommend a buffer ranging from 10-30 m depending on the area of the stream and its characteristics. This riparian area would apply to Morrison Creek and its tributaries, allowing for the maintenance of stream characteristics and Critical Habitat for Morrison Creek lamprey.

The RAR method is not without its disadvantages. The primary criticism is that it is not a species-specific method, but is designed for salmonids in an urban setting. However, the purpose of the RAR is to "establish directives to protect riparian areas from development so that the areas can provide natural features, functions, and conditions that support fish life processes" and so ensure that "there will be no harmful alteration, disruption or destruction of natural features, functions, and conditions that support fish life processes in the riparian assessment area" (B.C. Reg. 376/2004). If other methods become available which are better suited for the determination of riparian buffer zones for this species, they then can be applied to Morrison Creek and its tributaries.

Biophysical Functions, Features and Attributes of Proposed Critical Habitat for Morrison Creek Lamprey

The proposed critical habitat described here is believed to be necessary for Morrison Creek lamprey survival. The location and extent of proposed critical habitat are shown in Figure 1. Table 1 summarizes the best available knowledge of the functions, features and attributes needed for each life-stage of Morrison Creek lamprey. Note that not all attributes in Table 1 would need to be present in order for a feature to be identified as critical habitat. If the features as described in Table 1 are present and capable of supporting the associated function(s), the feature should be considered Critical Habitat even though some of the associated attributes might be outside of the range indicated in the table.

Table 1. General summary of the biophysical functions, features, attributes and location of potential Critical Habitat for Morrison Creek lamprey

Geographic location	Life stage	Function	Feature	Attribute
Morrison Creek and natural and artificial side channels of Morrison Creek and Arden Creek	Eggs and larvae	Incubation and rearing	Stream habitat	- Pebbles no greater than 1 cm diameter - Hard substrate covered with small pebbles/sediment - Cool, free flowing water available year round - Low water flow (0 to 0.7 m/s) - Depth 10-25 cm (Stone 2006) - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants - Sedimentation levels within natural variation
Morrison Creek and natural and artificial side channels of Morrison Creek and Arden Creek	Ammocoete	Feeding and rearing	Stream habitat	- Low to medium water flow - Loose silt, sand or mud substrate - Cool, free flowing water available year round - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants - Adequate food supply
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Adults	Spawning	Stream habitat	- Pebbles no greater than 1 cm diameter for building nests - Hard substrate covered with small pebbles/sediment - Cool, free flowing water available year round - Low water flow (0 to 0.7 m/s) - Depth 10-25 cm (Stone 2006) - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants - Sedimentation levels within natural variation
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Adults	Feeding	Stream habitat	- Availability of food supply of fish (exact species unknown) - Cool, free flowing water available year round - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants - Adequate supply of large and small woody debris and overhanging bank vegetation for shelter - Availability of small boulders and bank overhangs or muddy or silty substrates for shelter

Geographic location	Life stage	Function	Feature	Attribute
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Metamorphosing adults	Metamorphosis	Stream habitat	- Adequate supply of large and small woody debris and overhanging bank vegetation - Availability of small boulders and bank overhangs or muddy or silty substrates - Cool, free flowing water available year round - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Adults and metamorphosing adults	Feeding and metamorphosis	Vegetation within a riparian buffer zone of 10 m from the high water mark on both sides of the channel	- Stable banks - Provision of terrestrially supplied food and nutrients - Stable quality and quantity of surface water run-off during high rainfall conditions (within natural range of variation) - Adequate / stable shade cover for stream habitat - Supply of large and small woody debris and overhanging bank vegetation for shelter - Supply of plant litter to contribute to detritus
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Ammocoete	Feeding and rearing	Vegetation within a riparian buffer zone of 10 m from the high water mark on both sides of the channel	- Stable banks - Provision of terrestrially supplied food and nutrients - Stable quality and quantity of surface water run-off during high rainfall conditions (within natural range of variation) - Adequate / stable shade cover for stream habitat - Supply of large and small woody debris and overhanging bank vegetation for shelter - Supply of plant litter to contribute to detritus
Morrison Creek and natural and artificial side channels and tributaries of Morrison Creek	Eggs and larvae	Incubation and rearing	Vegetation within a riparian buffer zone of 10 m from the high water mark on both sides of the channel	- Stable banks - Provision of terrestrially supplied food and nutrients - Stable quality and quantity of surface water run-off during high rainfall conditions (within natural range of variation) - Adequate / stable shade cover for stream habitat - Supply of large and small woody debris and overhanging bank vegetation for shelter - Supply of plant litter to contribute to detritus

Activities Likely to Destroy Critical Habitat

Concern has been raised over the impact of anthropogenic activities such as urbanization, agricultural development and logging on the ecological integrity of Morrison Creek as well as to flow regimes in the watershed (Ellefson 2003). Activities that are likely to permanently or temporarily destroy Critical Habitat for Morrison Creek lamprey, include, but are not limited to the following:

- Land-based activities which have the capacity to alter aquatic habitat directly (e.g. impacts to riparian habitat, alteration of run-off rates or water storage capacity in headwaters) or indirectly (e.g. changes to water quality through introduction of pollutants). These activities include forestry, mining, and land development for industrial or residential uses. Of primary concern at present in the Morrison Creek watershed is forest harvest and urban development.
- The alteration of stream bed composition to better suit salmonids may result in the destruction of muddy/sandy areas in favour of large gravel suited for salmonid spawning.
- Water withdrawals and/or impoundment that result in water fluctuations that are greater than natural variability.
- Release of deleterious substances (e.g. hydrocarbons, pollutants and toxins).
- Riparian vegetation removal within the defined buffer areas around the stream and inflowing streams, or activities that degrade the normal function of riparian zones.
- Activities that generate significant sediment inputs into adjacent water bodies. Although turbidity values cannot be provided at this time, significant sediment influx into the stream could impair the osmoregulatory capacity of the animal. However, if water flows are maintained within natural variability it is unlikely that the water course would dry up from deposition of sediment.

Residence

Morrison Creek lamprey construct nests for spawning within the Morrison Creek watershed, which could be considered residences under SARA while they are being used for spawning or egg incubation (between April and July) because:

- They are discrete dwelling places that have a form and function similar to that of a nest.
- Adult lamprey of both sexes make an investment in creating a nests by using their bodies to excavate the depression and their oral disc to carry pebbles for the nest.
- The nests have the functional capacity to support the essential life-cycle processes of spawning and egg incubation.
- The nests are occupied by multiple individuals during spawning and egg incubation.

Sources of Uncertainty

There is limited information on water quality parameters for Morrison Creek. Additional hydrodynamic surveys are required to increase the scope of information on geospatial and hydrological properties of Morrison Creek.

The abundance of Morrison Creek lamprey is unknown.

The type and abundance of prey for the Morrison Creek lamprey is unknown

The type of vegetation needed to maintain the functions of the riparian zone (native vs. non-native plants) as required by the lamprey is unknown.

Information on spawning sites (locations, timing, etc.) is unknown.

It is not currently possible to provide quantitative thresholds for Critical Habitat attributes.

The quality of the identified Critical Habitat is unknown, but assumed to be variable, affecting local population density and reproductive success. Some areas of Critical Habitat are probably of lower quality due to natural variation, or the proximity of land-based activities, but they are, nevertheless, necessary for the survival or recovery of the species. It should be noted that, because there is little information regarding natural variation in water conditions, specific ranges cannot be recommend.

CONCLUSIONS AND ADVICE

Based on the best available information, the entire wetted area, channel and headwaters of Morrison Creek and its tributaries be considered Critical Habitat for the Morrison Creek Lamprey. This is the area that contains the Critical Habitat features and attributes that are necessary to support the life history functions of the Morrison Creek Lamprey. The role of the upper headwaters for maintaining water flow, quality and storage is particularly important. A hydrology study to examine the relationship between water sources and discharges from the system and further work to develop levels and thresholds for Critical Habitat attributes, in quantifiable terms specific to this species, be undertaken was recommended.

A riparian zone of 10 to 30 m, as determined by the RAR methodology, was recommended as forming a portion of Critical Habitat for the Morrison Creek Lamprey. The vegetation in this zone is Critical Habitat feature that supports the structure and function of the stream habitat and life history functions of Morrison Creek Lamprey. An analysis using the methods from the RAR or other applicable method is recommended.

Residence for Morrison Creek Lamprey includes the nests that Morrison Creek lamprey construct within the Morrison Creek watershed while they are being used for spawning or egg incubation.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 29, 2013 Review of the Information for the Identification of Critical Habitat for Morrison Creek Lamprey. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Beamish, R.J., 1985. Freshwater parasitic lamprey on Vancouver Island and a theory of the evolution of the freshwater parasitic and nonparasitic life history types. In Evolutionary Biology of Primitive Fishes. Edited by R.E. Foreman, A. Gorbman, J.M. Dodd and R. Olsson. Plenum, New York, pp. 123-140.

Beamish, R.J., 1987. Evidence that parasitic and non-parasitic life history types are produced by one population of lamprey. Canadian Journal of Fisheries and Aquatic Sciences 44:1779-1782.

Beamish, R. 2013. A summary of the early field studies of the Morrison Creek lamprey and a new assessment of its taxonomy. Canadian Journal of Fisheries and Aquatic Sciences. 3031: iv + 36 p.

Beamish, R.J., and R. E. Withler, 1986. A polymorphic population of lampreys that may produce parasitic and nonparasitic varieties. Indo-Pacific Fish Biology: Proceedings of the Second International conference on Indo-Pacific Fishes. Edited by T. Uyeno, R. Arai, T. Taniuchi and K. Matsuura, 1986, pp.31-49, Ichthyological Society of Japan, Tokyo.

Beamish, R.J., J. H. Youson, and L.A. Chapman. 1999. COSEWIC status report on the Morrison Creek lamprey, Lampetra richardsoni, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-14pp

Beamish, R.J., J. H. Youson, and L.A. Chapman. 2001. Status of the Morrison Creek Western Brook Lamprey, *Lampetra richardsoni*, in Canada. Canadian Field-Naturalist 115(4): 573-578.

Ellefson, J. 2003. Morrison Creek headwaters sensitive habitat inventory and mapping report. Comox Valley Project Watershed Society, Courtenay, BC.

National Recovery Team for Morrison Creek Lamprey. 2007. Recovery Strategy for the Morrison Creek Lamprey (Lampetra richardsoni var. marifuga) in Canada. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa. v + 24 pp. (Accessed January 12, 2015)

Stone, J. 2006. Observations on Nest Characteristics, Spawning Habitat, and Spawning Behavior of Pacific And Western Brook Lamprey In A Washington Stream. Northwestern Naturalist. 87(3). 225-232.

Youson, J.H., and R.J. Beamish. 1991. Comparison of the internal morphology of adults of a population of lampreys that contains a non-parasitic life history type, *Lampetra richardsoni*, and a potentially parasitic form *L. richardsoni* var. *marifuga*. Canadian Journal of Zoology 69:628-637.

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